SYNECTIC DESIGNS LLP

CENTRE OF EXCELLENCE

HARNESSING THE POWER OF RESEARCH, INNOVATION AND KNOWLEDGE HUB

APRIL, 2025

Today Research in Universities are an undervalued force for change. The realization that Centre of Excellence (CoE) can be an essential Knowledge Catalyst between a Professional Venture and a Trusted Partner towards Academics as ‘anchor institutions’ shall promote proximity to research, innovative teaching, strong partnerships and entrepreneurial spirit. By educating the next generation of critical and creative thinkers, the CoE will make a significant contribution to the common good and the preservation of societal well-being, natural resources and the environment.

INTRODUCTION

The Need for a Center of Excellence in Higher Education

Higher education institutions are evolving beyond traditional teaching and research models. There is a growing demand for institutions to offer students practical exposure, interdisciplinary learning, and industry-driven experiences. A **Center of Excellence** helps bridge the gap between academic knowledge and practical application, giving students opportunities to work on real-world projects, collaborate across disciplines, and engage in meaningful research and entrepreneurship.

Traditional academic programs often operate in silos, limiting students' exposure to ideas and approaches from different fields. A domain-agnostic CoE removes these barriers, allowing students and faculty to explore diverse topics and work on problems that require inputs from multiple disciplines. This fosters an environment where innovation is not confined to specific departments but thrives across the institution.

Why Domain and Technology Agnostic?

Many institutions establish centers of excellence focused on specific Domain or Technology, such as artificial intelligence, biotechnology, or Construction Technologies. While these centers provide specialized domain and technical knowledge, they often fail to provide a comprehensive outlook and exclude individuals from other fields who could contribute valuable insights. A Domain and Technology-agnostic approach ensures that anyone, regardless of their background, can participate and contribute.

This model encourages:

- Cross-disciplinary collaboration, where engineers, designers, business professionals, and scientists can work together on a particular Business Domain with enabling technology to mitigate challenges.
- A broader range of problem-solving approaches, as different disciplines bring unique perspectives to the table.
- Greater flexibility, allowing the center to adapt to emerging trends and technological advancements rather than being confined to a single field.

Key Objectives

- **Facilitate Interdisciplinary Learning:** Encourage knowledge-sharing across fields such as technology, business, sciences, and humanities.
- **Promote Research and Innovation:** Support cutting-edge research and provide a platform for translating ideas into tangible solutions.
- **Enhance Skill Development:** Offer training programs, certifications, and workshops on emerging technologies, entrepreneurship, and leadership.
- **Foster Industry Collaboration:** Partner with leading organizations to provide real-world exposure and funding opportunities.
- **Support Startup Incubation:** Provide mentorship, seed funding access, and networking opportunities to budding entrepreneurs.
- **Enable Policy and Thought Leadership:** Contribute to national and global discourse on innovation, education, and economic growth.

Alignment with Institutional and Industry Goals

For a CoE to be successful, it must align with the goals of both the educational institution and industry partners. Academic institutions benefit from improved student outcomes, increased research output, and stronger connections with industry. Companies gain access to a talent pool that is trained in practical, interdisciplinary problem-solving and innovative thinking. By aligning with institutional priorities such as employability, research excellence, and entrepreneurship, the CoE becomes an integral part of the university's mission. Simultaneously, industry collaborations ensure that the CoE remains relevant and provides value to both students and external stakeholders.

The success of this CoE will depend on its ability to create opportunities for students and faculty to engage with industry, develop innovative solutions, and contribute to meaningful advancements in various fields. This foundation will be key in establishing the CoE as a model for higher education institutions looking to drive impact beyond traditional academic structures.

Expected Impact

The CoE is expected to create a long-lasting impact on students, faculty, and the broader academic and industrial ecosystem through:

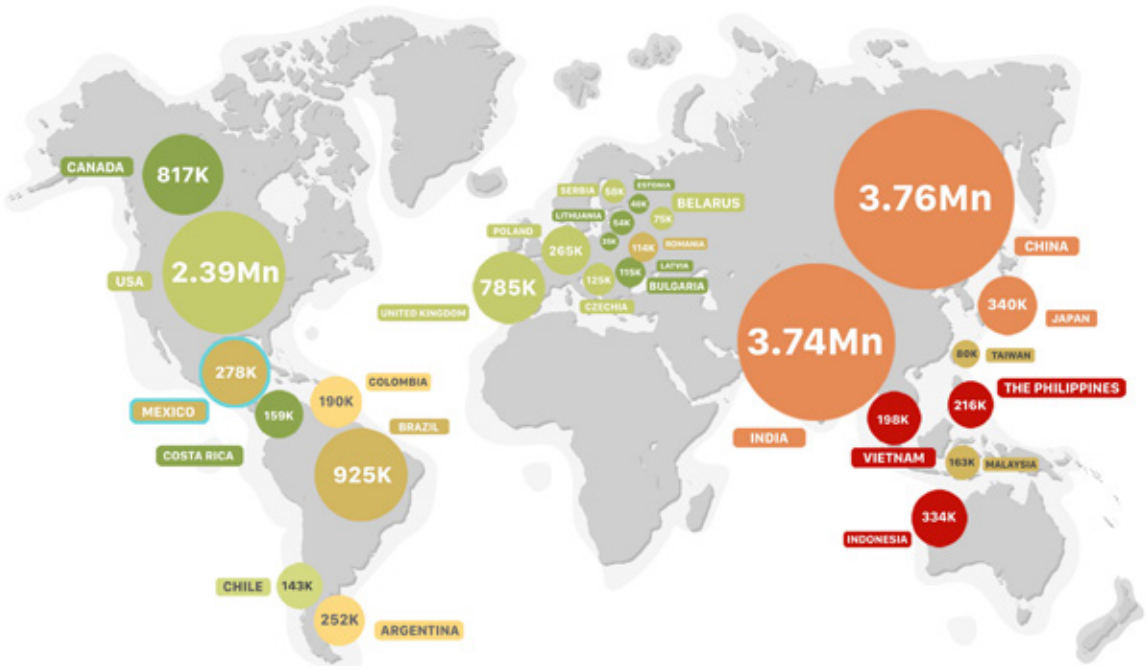
- Increased employability and skill readiness of students.
- Higher research output with industry-aligned projects.
- Greater innovation and entrepreneurship activities within the institution.
- Strengthened academia-industry partnerships leading to collaborative problem-solving.
- Contribution to regional and national development goals by driving innovation-driven economic growth.

CURRENT CHALLENGES

India has plenty of STEM graduates (30.74 lakh software engineers graduates every year), but lacks top talent to lead in emerging tech. The country ranks a 7th in Artificial Intelligence (AI) as it aims to leverages new technology. The widened skill shortage and gap in right skills has grown up from 64% in 2019. To compete in the Digital Economy, India's traditional workforce skills need to be upgraded. However a significant portion of the workforce remains ill-equipped for market demands. Few Startling Facts indicate the challenges in skills and talent gaps:

- A February 2025 Guru Gobind Singh Indraprastha University study "Hero Sills of the Future – Vision 2030: Emerging careers, Skills and Opportunities for growth" found that 77% of Indian Professionals feel inadequately skilled in technologies their employers consider essential.
- Nasscom's 2022 report, "Reskilled upskill Now: The Mantra of Future Fitting the Technology Workforce", about 150 Mn people will need reskilling or upskilling by 2025 to meet industry demands.
- A 2022 Alpha-Beta- Amazon Web Services (AWS) study, "Building Digital Skills for the changing workforce in Asia Pacific and Japan", estimates that India will need 3.9 Mn cloud professionals by 2025, but currently has fewer than 1.5 Mn. With evolving technologies at rapid pace, some skills are becoming obsolete at rapid pace.
- Although formal sector companies are investing heavily in training programmes, only a fraction of these initiatives lead to tangible improvements, while 28.33% of workers from informal sector upskill their tasks through self-learning or methods that are insufficient to equip individuals with the competencies required for emerging business domains and technology sectors.

Talent availability across key hotspots



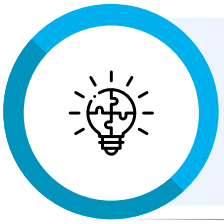
Source: COE Hotspots Of The World 2024 by Zinnov

Some of the reasons for above mentioned challenges are:

No Standard Framework – India has diverse job market spanning numerous sectors and industries. Assessing current skills and align them with future jobs remain elusive. The new technologies provide real-time insights between employee capabilities and organizational needs and that present unique challenge in India.

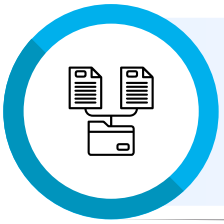
No Skills Taxonomy – There is lack of shared consensus on defining skill. Deloitte's 2022 report, "The Skills Based Organization: A New Operating Model for Work and the Workforce", said that only 15% of Indian companies have a well-defined skill taxonomy. Unlike the global workforce which is expected to shift in the job role, India faces challenges of aligning skills with new roles. For instance, growing demand for data scientists or cybersecurity analysts usually outstrips supply of professionals in these areas. NASSCOM report states that India's growing financial sector requires 1 Mn cybersecurity professionals by 2027. Only around 3 lakhs are available today. New college graduates can only fill a quarter of the advanced technology jobs.

To address these challenges, businesses, Government and academia must join hands to adopt a heterogenous approach. Some important pointers are as follows:

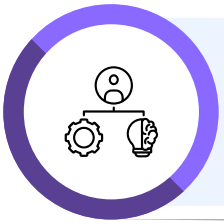


Assess Skills Gaps: Adapt AI Powered tools to identify real-time skills gaps accurately. Learning Management Platforms such as Skillsoft and coursera for Business can recommend skills paths based on goals and existing skills.

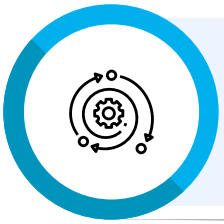
Invest in continuous Learning and Development: While some companies have been running constant learning and development in the tech sector, similar efforts must be embraced across industries and SMEs. Pradhan Mantri Kaushal Vikas Yojana (PMKVY) can be useful upskilling young workers. But PPPs are needed.



Develop a Skills Taxonomy: This will ensure consistency in defining and categorizing skills across industries. NSDC is making efforts to create a universal framework like the European Qualification Framework.



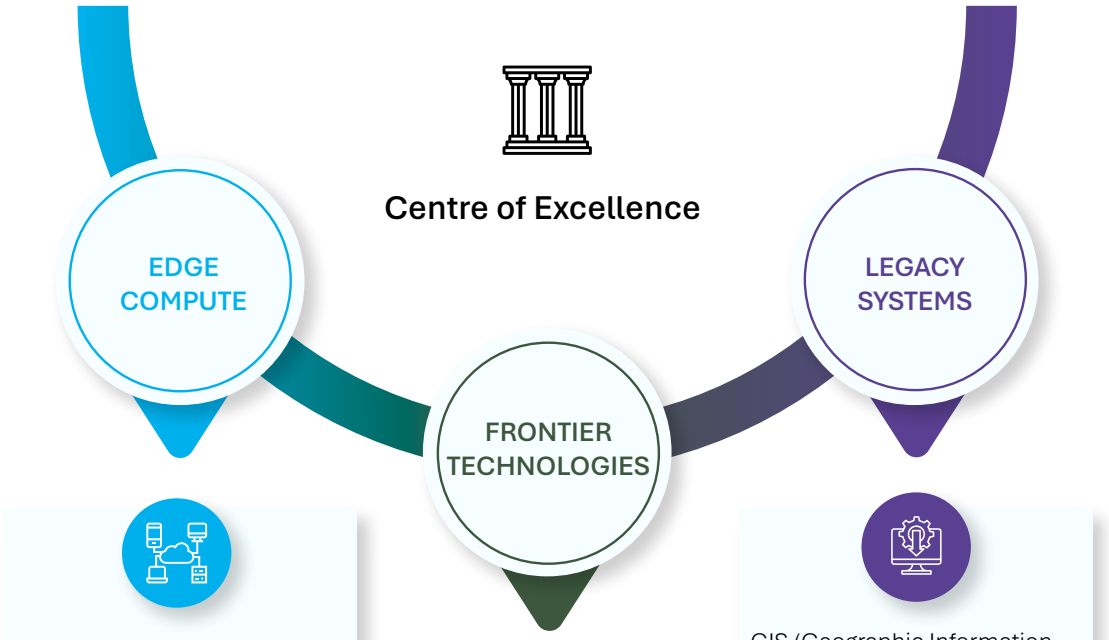
Align Education with Industry Needs: Academia should play a key role by incorporating practical skill development in curricula. Collaborations between universities and companies will produce students with employable skills.



Track Impact: Invest in real-time skills tracking tools to monitor employees progress and training impact. HR can then align development programs with evolving business needs.

STRATEGIC FRAMEWORK

The Center of Excellence based on Spatial technology Ecosystem embodies our commitment to harness the power of Earth Observation satellites, Spatial Survey techniques, Spatial Information comprising of geospatial, Building information, Supervisory Controls and 3D Visualization technology for the benefit of our nation. The Center of Excellence is a multitude of shared components including Global Capability Centre, Data Observatory, Innovation and Start-up Incubation Centre. It has a ecosystem comprising of following technology platforms



Drones/ UAVs (unmanned Aerial Vehicles), DGPS (Differential Global Positioning System) Field Survey, GPS (Global Positioning Systems) based Location Based Services, Robotics and Sensors

Digital technologies
AI (Artificial Intelligence), IoT (Internet of Things), Big Data, Blockchain, Industry 4.0

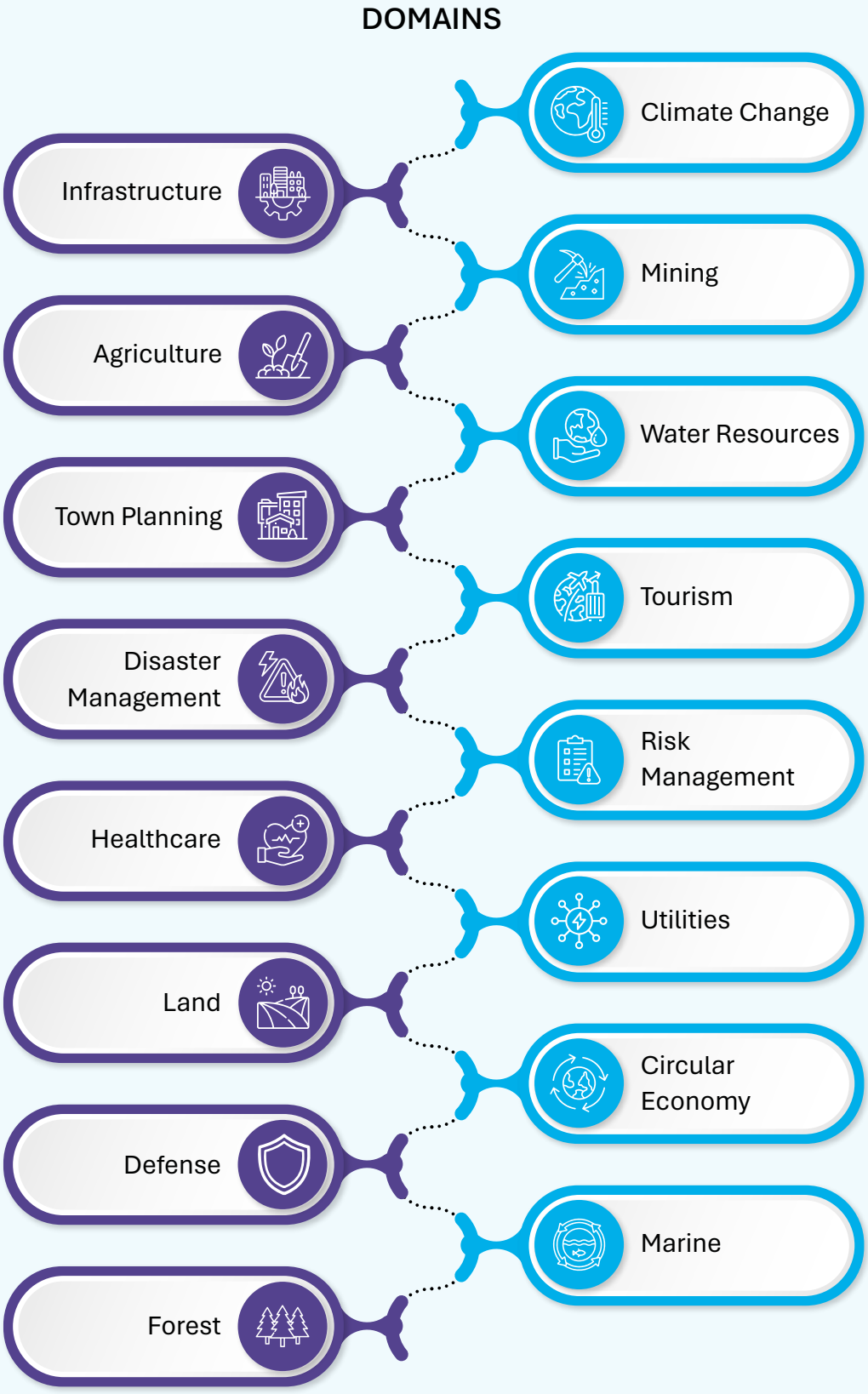
Physical Technologies
Wearable Technology, Autonomous driving, 3D printing and hardware innovations

Biological Technologies
Biobanks, Bioprinting, organoids, genetic engineering, human augmentation and the brain-computer-interface

GIS (Geographic Information Systems), CAD (Computer Aided Design), SCADA (Supervisory Control and Data Acquisition), BIM (Building Information Management), 3D Digital Twin and other Engineering Modelling Software

Paving the way

The Center of Excellence for Spatial Technology Ecosystem shall be characterized by its curiosity-driven approach to science, proximity to research, innovative teaching, strong partnerships and entrepreneurial spirit. Digitalization is shaping all sectors of the economy and numerous facets of our lives



The proposed Centre of Excellence identifies several global challenges that are of particular importance in the context of education, research and innovation in the period leading up to 2028. The proposed Centre of Excellence is well positioned to contribute to India's solutions aimed at addressing these most pressing global challenges.

- Encouraging and ensuring scientific excellence and promoting, ensuring new forms of employment
- Strengthening the dialogue between science and society for more inclusive and ethical decision-making
- Generating comprehensive environmental and societal knowledge and working towards a positive environmental impact
- Enabling access to a global and inclusive education
- Accelerating technology for the benefit of people and the planet

GLOBAL MARKET INSIGHT

A CoE can be described as a competency or capability center run by a group of experts for a focus area to rise above the changes brought by disruptions and ensure alignment around a common purpose. The CoE is usually built around critical processes, technologies, or applications to help Students, professionals to understand a Technology platform, domain specific processes and eventually become more efficient by nurturing best practices, leadership, research, training, and support for a subject area.

With a CoE in place, its easy to identify pooled resources to create a consistent process, sustainable products and solutions for **Government to Citizens (G2C), Government to Government (G2G) and Citizen to Citizen (C2C)** Interface.

The COE shall continually develop the diverse solutions in the key focus areas that are particularly important in context of India. All three strategic focus areas of CoE shall open up equal possibilities for exploratory research, applied research and new avenues in solving national and global challenges. Interdisciplinary collaboration will strengthen all domains where these technologies could be positioned as real-world applications, education and training programs. The Market Opportunities indicates Mega Technology Trends in Public Sector Urban and Rural Service operations with 60% of transactions are through digital channels

EDGE COMPUTE	FRONTIER TECHNOLOGIES	LEGACY SYSTEMS
Drone and LiDAR survey USD 508 Million by 2027	**IOT** USD 650.5 billion by 2026	**GIS** USD 55.75 billion by 2029
DGPS USD 5.2 Billion by 2029	**Artificial Intelligence (AI)** USD 459.3 Billion by 2030	**3D Digital Twin** USD 110.1 Billion by 2028
Location Based Services (LBS) and Real Time Location Services (RTLS) USD 60.4 Billion in 2029	**Blockchain** USD 248.9 Billion by 2029	**PLC SCADA** USD 16.6 Billion by 2029
Global Earth Observation Satellite Services USD 115.4 billion by 2028	**Industry 4.0** USD 182.01 Billion by 2029	**BIM** USD 14.8 Billion by 2029
	BioBank US$5.0 Billion by 2028	

GLOBAL TRENDS

In the global economy, there is a rise in automation and digital transformation, which is driven by the need for improved efficiency, reduced costs, and enhanced quality. The proposed Center of Excellence recognizes following trends relevant from the viewpoint of Urban and rural settings, healthcare, Utility services, risk and vulnerabilities of critical infrastructure, challenges to supply chain security.

1. **Launch of Green Grids Initiative**
   One Sun, One World and One Grid through Sustainable Energy Digital Platform
2. **Digital Underground Sensing**
   Digital Twin for representation of existing and future sub-surface utilities
3. **Marine – Smart port and Integrated Supply Chain Services,** Virtual Vessel with Ship Control Systems
4. **Bio bank as Healthcare Services**
   Large-scale biomedical data linked to Environment, Climate Change
5. **Ground Station as Service**
   Earth Observation data fused with IoT, Drone through LoRa WAN and Bluetooth Beacon Network
6. **Sustainable 4.0**
   Circularity Economy, Virtual reality for remote maintenance and inspections.
7. **Risk, Vulnerabilities of Critical Infrastructure and Economic Resilience** covering Terrestrial and Marine Ecosystem
8. **National Digital Twin**
   Real-time data, used for simulation, prediction, and informed decision-making

REIMAGINING COE

POLICIES AND PROCESSES

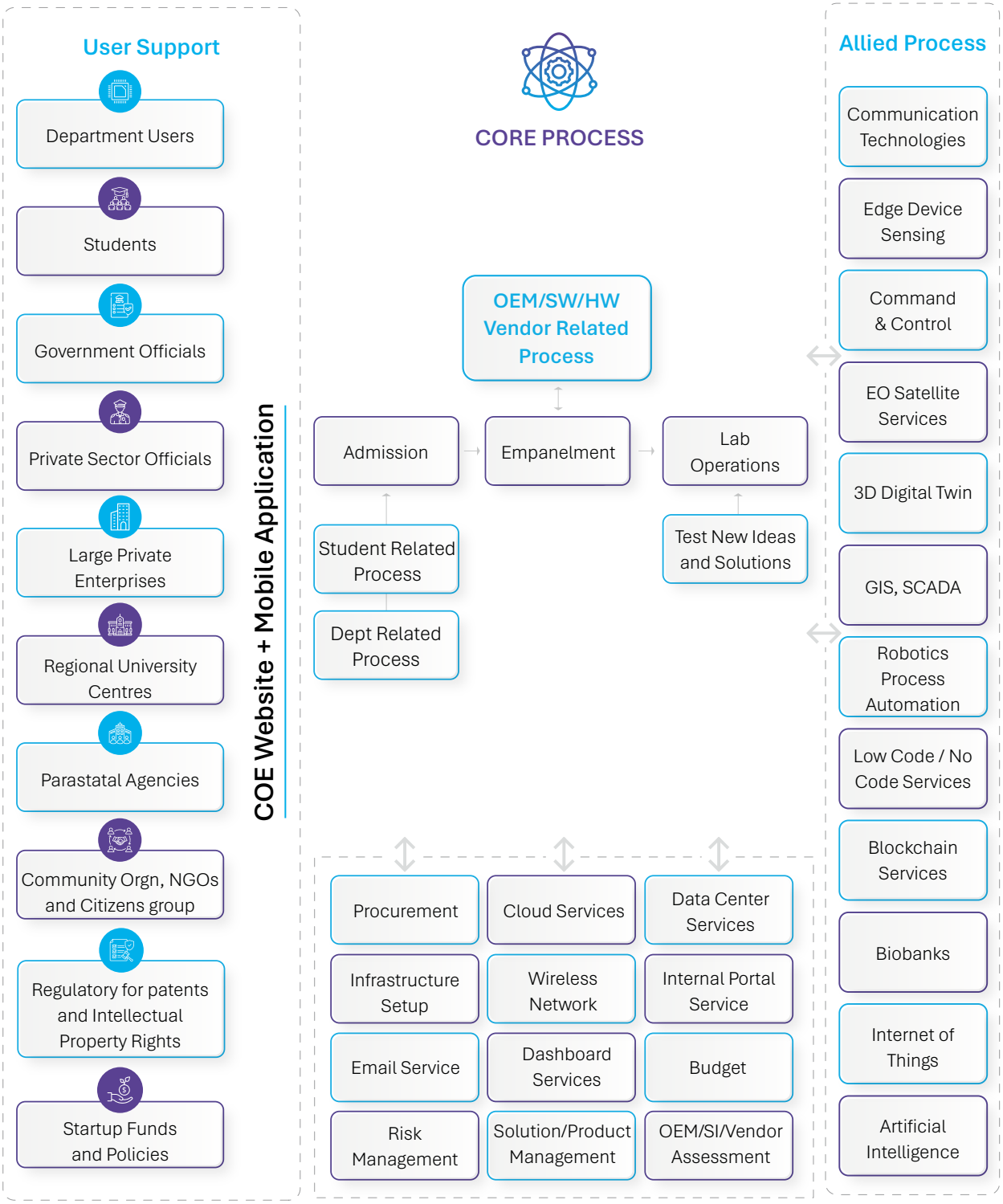
Processes during COE Development

Given the current situation where COE is a start-up operation and is at a building phase, the initial processes are required to be set which would be used primarily for the self use of COE. During this phase, the COE as organization requirements would be growing at a rapid pace. During this phase it is important that the processes are institutionalized, which would help to prioritize the phases of development and services its "customers" in a better manner. The CoE would also be able to meet the expectations of the OEM/ System Integrators and Vendors within the SLAs mutually defined for the benefit of Students, professional and Faculty Members within COE.

During this phase, the COE would be undertaking various activities/projects and it is important that in this phase of rapid flux, the internal processes for service delivery are also set, so as to streamline and co-ordinate various activities undertaken by various teams (outsourced or internal) for this activity as well.

Steady State Processes

At a steady state, the COE Uniqueness would provide Research, innovation and sustainable solutions. This would be possible only when the processes are robust and strictly followed. At this stage there should be no exceptions to the suggested processes. This has to be re-enforced though effective MIS tracking and defining KPIs for the Department/Process/Sub-processes Heads and periodic process audits.



The Centre of Excellence is defined as: "user-centered, open innovation ecosystems based on a systematic user co-creation approach, integrating research and innovation processes in real-life communities and settings".

Sub-Processes of COE - The key sub-processes identified under the different processes are as follows:

Admission

1.0 Student Admission Management

- 1.1 User Profiling
- 1.2 Authentication
- 1.3 Online Application
- 1.4 Study Material and other content Management
- 1.5 Research Services
- 1.6 Best Practices and Case Studies

2.0 Examination and Certification

- 2.1 Learning Management System
- 2.2 Video Interface
- 2.3 Virtual Assistant
- 2.4 Proctor module

3.0 Department Related Sub Process

- 3.1 Course Curriculum
- 3.2 Mentor Records
- 3.3 Testing and Accreditation
- 3.4 Research Credit Repository
- 3.5 Study material

4.0 Lab Related sub-process

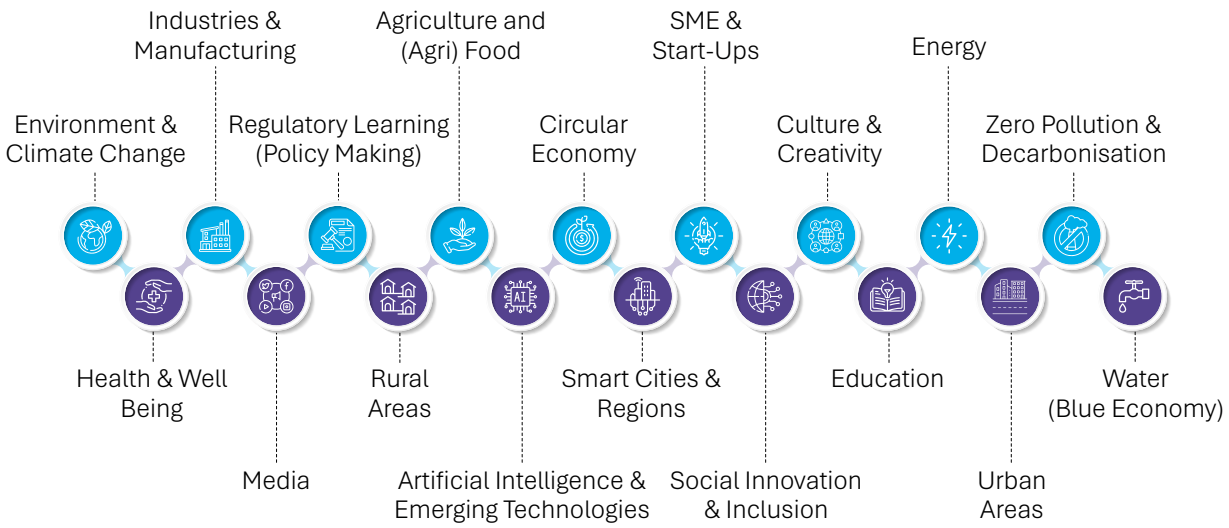
- 4.1 Research Methodology
- 4.2 Rapid Prototyping
- 4.3 Benchmarking Products/Solutions for Industry release
- 4.4 Hackathons and Trainings
- 4.5 Lab Technicians, Mentors and Event Coordinators
- 4.6 Workshops and Bootcamps

5.0 Project Management

- 5.1 Project Initiation
- 5.2 Project Planning and Execution
- 5.3 Project Closure
- 5.4 Project Monitoring and Control

6.0 Quality Control and Management

- 6.1 CoE Projects
- 6.2 CoE Processes

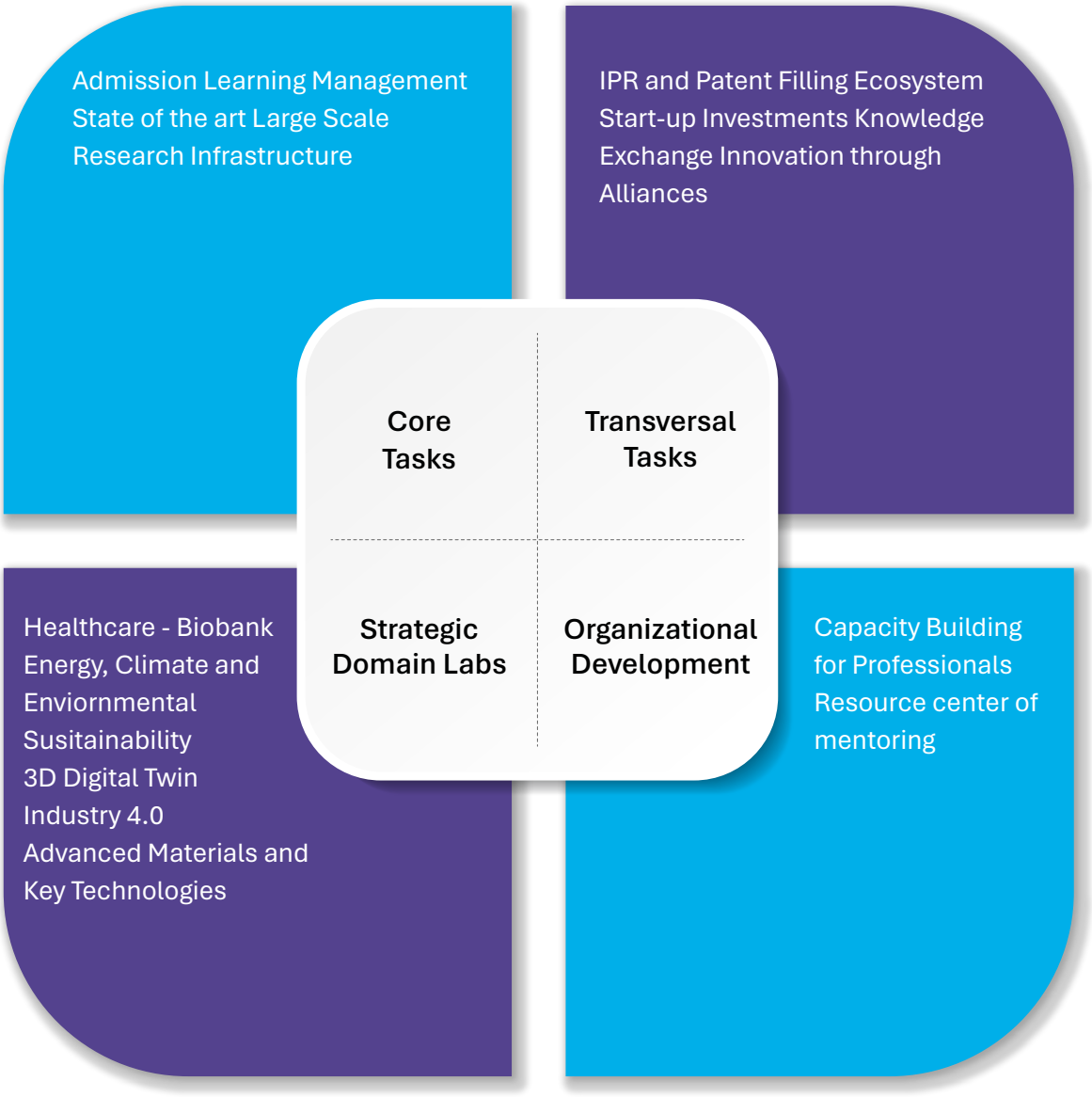


Governance and Leadership Structure

A well-structured governance model and Alliances with external partners is essential to foster large, time-bound public sector projects. The leadership team will include:

- Director of the CoE: Responsible for overall vision, strategy, and management.
- Academic and Industry Advisory Board: A mix of faculty members and industry professionals who provide guidance and ensure alignment with industry trends.
- Program Coordinators: Faculty members and administrative staff managing specific programs within the CoE.
- Student and Research Fellows: Actively engaged students and researchers driving projects and initiatives.

The CoE shall evaluate project-based engagement with emphasize on importance of fundamental discovery and innovation as the cornerstone of research activities with applied solutions



Implementation Roadmap

A structured and phased approach is essential for the successful establishment and operation of the Domain and Technology-Agnostic Center of Excellence (CoE). This roadmap provides a step-by-step guide to the implementation process, outlining critical phases, milestones, and success metrics.

1. **Phase-Wise Development Plan - The implementation of the CoE will be carried out in multiple phases to ensure steady progress and adaptability.**

1 Planning and Foundation (Months 1-6)

- Define the CoE's mission, vision, and core objectives in collaboration with institutional leadership.
- Secure initial funding through institutional support, grants, and industry partnerships.
- Identify and allocate physical infrastructure (labs, co-working spaces, digital platforms).
- Recruit key personnel, including the Director, faculty coordinators, and advisory board members.
- Establish governance policies and operational frameworks.
- Initiate discussions with industry and academic partners for collaborations and MoUs.

2 Pilot Programs and Initial Rollout (Months 6-12)

- Launch pilot training programs with use cases and research initiatives to assess student and faculty engagement.
- Establish an initial set of industry collaborations and funded research projects.
- Develop a digital platform for knowledge sharing, program enrollments, and networking.
- Begin offering startup incubation support, including mentorship, networking, and prototype funding.
- Collect initial feedback from participants and stakeholders to refine offerings.

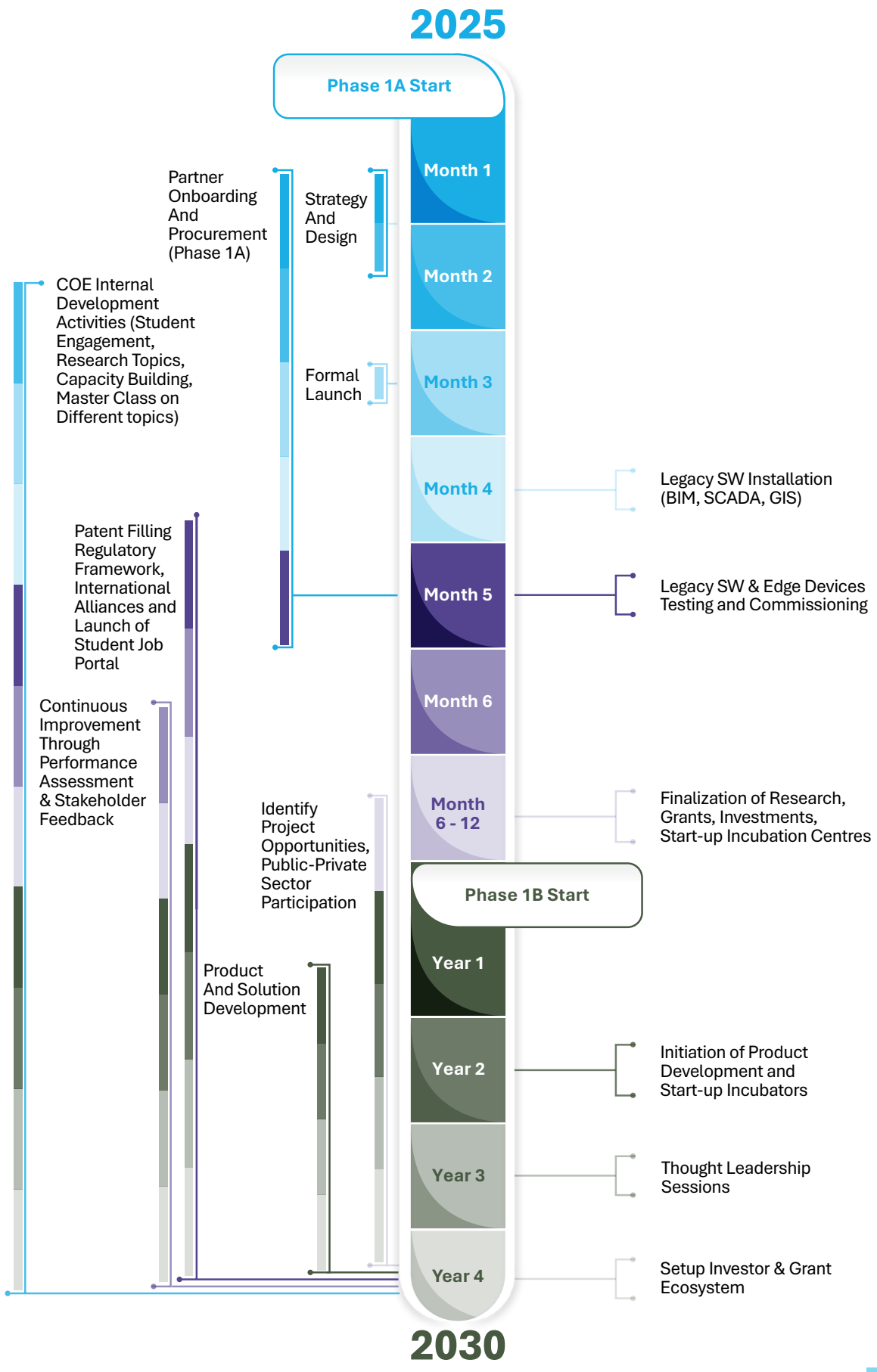
3 Scaling and Expansion (Year 2-3)

- Expand training and research programs based on initial pilot outcomes.
- Strengthen industry tie-ups, bringing in more companies for collaborative projects.
- Develop specialized labs and resources based on demand and technological trends.
- Introduce structured interdisciplinary projects that require collaboration across fields.
- Establish an alumni network to drive mentorship and funding support.
- Host conferences, hackathons, and innovation challenges to engage a wider audience.

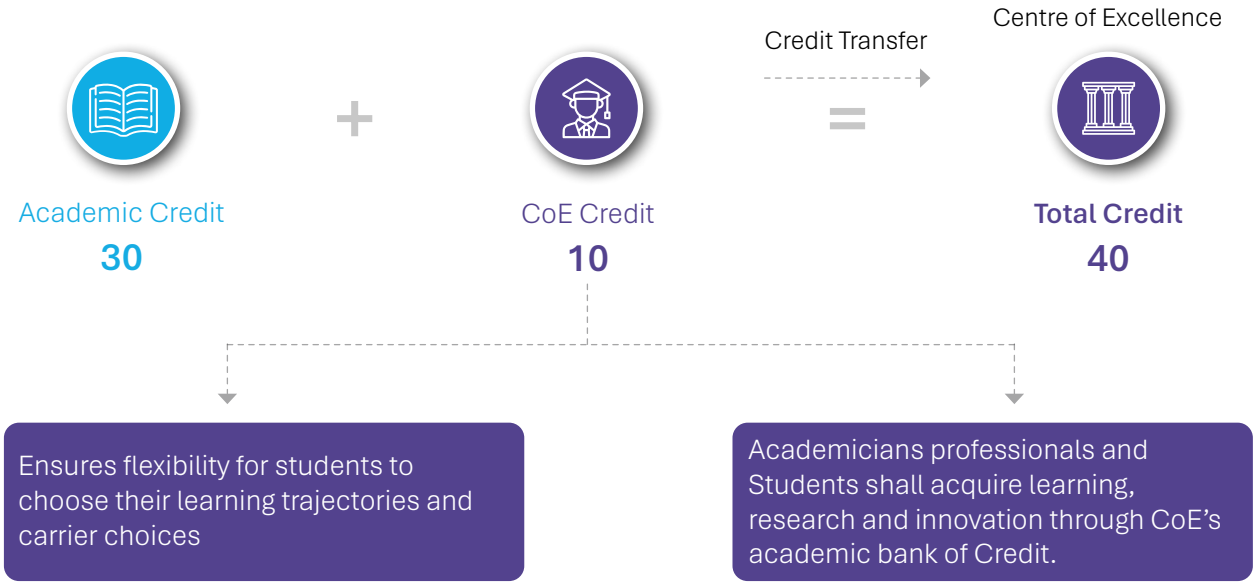
4 Institutional Integration and Long-Term Sustainability (Year 4 & Beyond)

- Integrate CoE programs into the broader academic curriculum, allowing credit-based participation.
- Diversify funding sources to ensure financial sustainability through memberships, consulting, and startup equity.
- Expand collaborations with global institutions, encouraging student exchange and joint research.
- Build a strong reputation through publications, patents, and success stories from startups and projects.
- Implement a continuous improvement model based on performance assessments and stakeholder feedback.

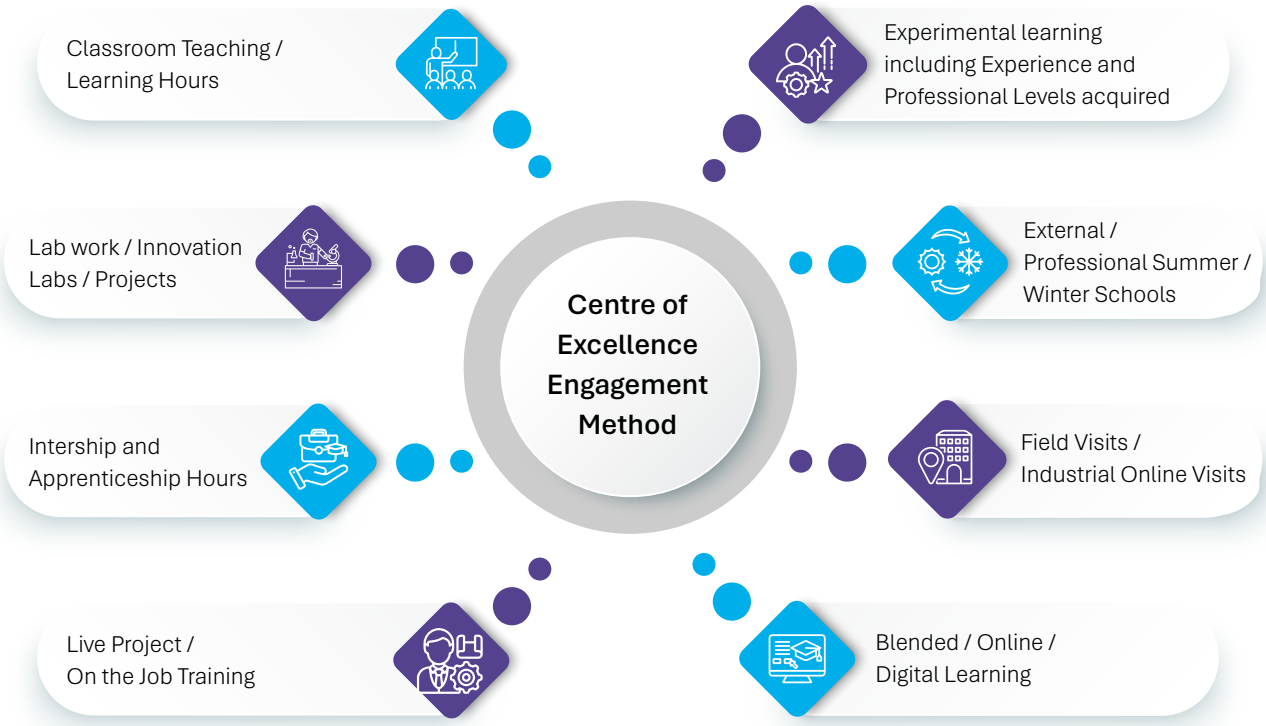
Key Milestones and Success Metrics



Adopting NEP's 2022 – National Credit Framework



Note: 1 Credit equivalent to 30 hours of total study



CoE Governance using Digital Public Goods (DPG)

1

G2C & C2G - CoE Portal

- List of Government Programs, Research Initiatives
- Details of Public Sector Funding
- List of Pilot Projects, PoCs, Lighthouse Project Initiatives
- Enhanced engagement, training, knowledge repositories

2

G2B Vendor onboarding

- Define SLA as per Experience, Best Practices, GIGW guideline
- CoE empaneled vendor onboarding
- Business Process and SLA monitoring

3

C2C Enhanced Management

- Utilize Government Cloud Service for Enhanced Citizen Applications
- Create a Foundation for Digital Public Infrastructure and Data Systems
- Empower Citizens with Digital Capacity Building Exercises

Satellite Ground Station

Earth Observation satellite Data as Service.

Sub-Surface Utilities

3D Digital Twin and BIM easing Geo-technical investigations.

Drone, GNSS and DGPS

Testing with Industry 4.0 (Robotics, AI, IoT)

Learning Management Platform

Virtual Training Environment GIS, PLC SCADA, BIM

AI/ML, Blockchain, IoT

Intelligent Operations Insight in different domains

Focused Learning Paths within Center of Excellence

Learning Path	Key Learnings	Career Outcomes
AI & Machine Learning	– Fundamentals of AI/ML – Neural Networks & Deep – Learning MLOps & – Deployment Responsible & Ethical AI	– AI/ML Engineer – Data Scientist – AI Solutions Architect
Satellite Ground Station	– Satellite Communication & EO Data – Ground Station Operations – Remote Sensing & Data Interpretation	– Satellite Data Analyst – Ground Station Operator – EO Systems Specialist
BIM (Building Information Modelling)	– BIM Tools & Workflows – Project Lifecycle Management – Data Interoperability & Visualization	– BIM Coordinator – Construction Technologist – Digital Project Manager
Industry 4.0	– Cyber-Physical Systems – Smart Manufacturing – IoT, Robotics & Automation – Digital Twins	– Industry 4.0 Specialist – Automation Engineer – Smart Factory Consultant
Geospatial Infrastructure	– GIS & Mapping Tools – SCADA & IoT Systems – Drone Mapping & Spatial Analysis	– GIS Analyst – Geospatial Developer – Infrastructure Monitoring Lead
3D Digital Twin	– 3D Modeling & Visualization – Integration with IoT/BIM – Simulation & Predictive Analytics	– Digital Twin Engineer – Smart Infrastructure Analyst – Simulation Expert
Biological Technologies	– Biobanking & Genomics – Human Augmentation & BCI – Ethical & Regulatory Frameworks	– Biomedical Researcher – Genomic Data Analyst – Neurotechnology Developer

Guiding Policies for CoE

National Geospatial Policy 2022

1

- Deregulated the Geospatial Sector and liberalize data acquisition/ production
- Seeks to develop Geospatial infrastructure, skills and knowledge, standards
- Promote innovation and Research involving private sector

National Data Sharing and Accessbility Policy 2022

2

- Recognition of Asset and Value potential of Data
- Promote openness, flexibility, transparency, legal conformity, protection of intellectual property, interoperability, quality, security, efficiency, accountability, standards, professionalism. Sustainable and privacy

Policy on Open Application Programming Interfaces (APIs) 2014

3

- APIs are published by all Public Sector organizations for E-Governance applications and Systems
- Promote and expedite innovation based on availability of data from e Governance applications and systems to the public.

Indian Space Policy 2023

4

- To augment space capabilities; Encouraging advanced Research & Development in space sector
- Promoting space-related education and innovation, including support to space-sector start-ups
- Nurture scientific temperament in the society, and increase awareness on space activities by involving Non-Government Entities

Information Technology Act 2000 Digital protection Data Protection Act, 2023

5

- Establish legal recognition to electronic transactions by means of electronic commerce
- Preventing Cybercrimes, protecting Data Privacy and personal Data
- Regulation of Intermediaries such as Social media Platforms and Internet Service providers

Universal Grants Commission (UGC) Act, 1956

6

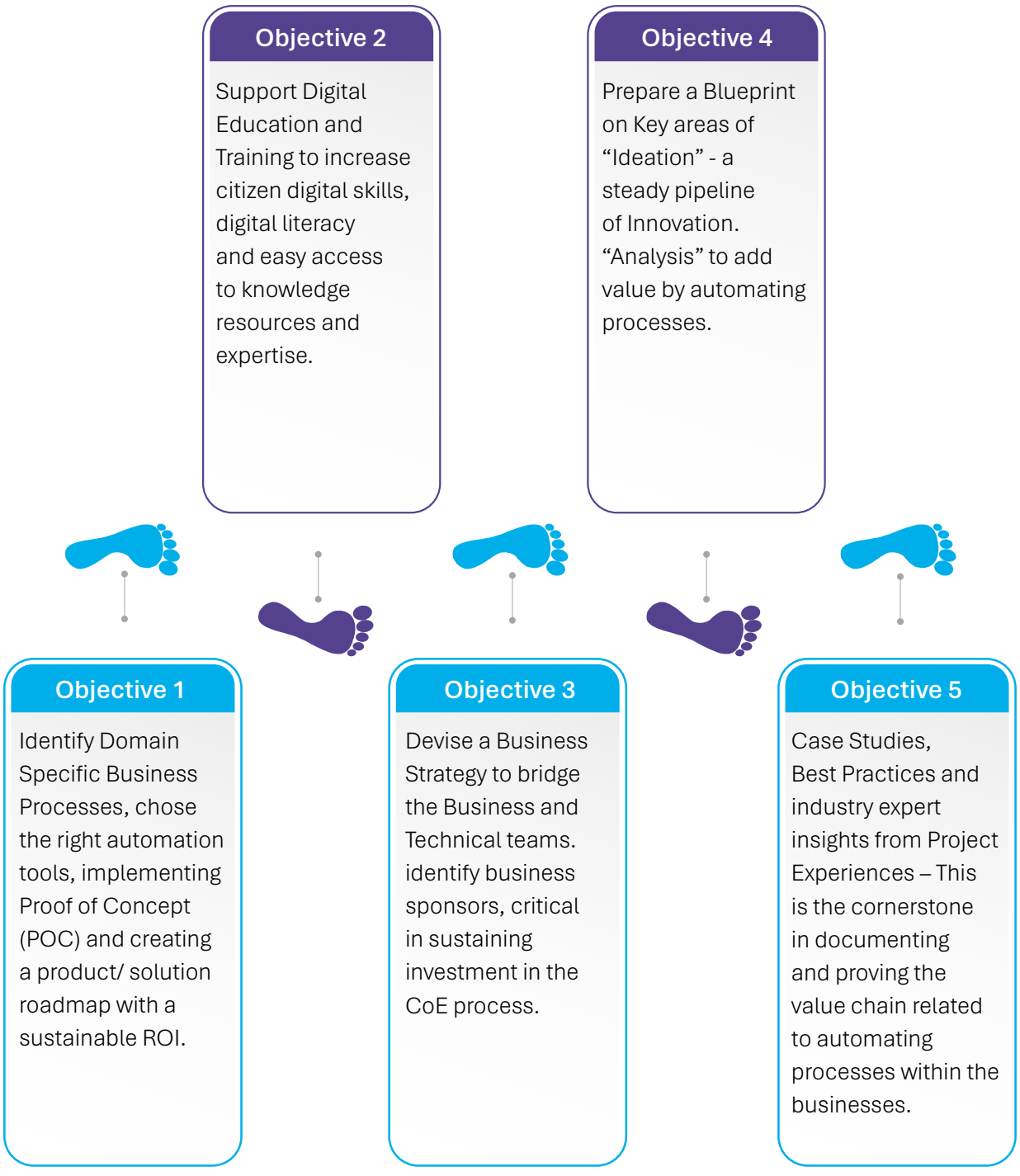
- Coordinate, determine, and maintain standards in higher education, including universities and colleges
- Regulates minimum qualifications for teachers and other academic staff, and recognition of colleges

Public Procurement Act 2012

7

- Ensuring transparency, accountability, and probity in the procurement process
- Achieving cost-effective, quality-controlled, and timely delivery of goods and services
- Promoting fair and equitable treatment of bidders and encourage competition

Next Steps


Objective 2
Support Digital Education and Training to increase citizen digital skills, digital literacy and easy access to knowledge resources and expertise.
Objective 4
Prepare a Blueprint on Key areas of "Ideation" - a steady pipeline of Innovation. "Analysis" to add value by automating processes.
Objective 1
Identify Domain Specific Business Processes, chose the right automation tools, implementing Proof of Concept (POC) and creating a product/ solution roadmap with a sustainable ROI.
Objective 3
Devise a Business Strategy to bridge the Business and Technical teams. identify business sponsors, critical in sustaining investment in the CoE process.
Objective 5
Case Studies, Best Practices and industry expert insights from Project Experiences – This is the cornerstone in documenting and proving the value chain related to automating processes within the businesses.

CASE STUDIES AND BEST PRACTICES

CASE STUDIES IN SMART INFRASTRUCTURE

AI, IoT, GIS & Digital Twins

This document presents a series of advanced smart infrastructure solutions implemented across urban India, utilizing cutting-edge technologies such as AI, IoT, GIS, and digital twins. These real-world case studies offer valuable insights into operational efficiency, public safety, revenue optimization, and sustainability. International benchmarks are cited to underline scalability and impact potential.

1 Smart Fire Prevention in Food Plazas

Challenge: Urban food courts face recurring fire incidents due to poor electrical systems and unattended cooking practices.

Solution: AI-IoT fire detection with real-time heat maps, alerts, and sensor-based triggers.

Features:

- Heat detection via AI-driven thermal cameras.
- Smoke sensors integrated with IoT modules.
- Real-time alerts through cloud-based dashboards.

Global Example: Singapore›s Hawker Centres use predictive AI sensors and automatic suppression systems, leading to a 40% reduction in fire cases.

Indian Context: Implementable in malls, markets, and food plazas under municipal building codes.

2 Circular Waste Management with AI-IoT-GIS

Problem: High waste generation from hospitality clusters leading to inefficient management and revenue leakage.

Solution: Smart bins, AI-based waste categorization, GIS monitoring of illegal dumping, and dynamic routing.

Technologies:

- Fill-level sensors.
- Machine vision for waste sorting.
- Geo-tagged collection routes.

International Benchmark: Seoul's smart waste system cut overflow incidents by 70% and improved collection efficiency by 40%.

Scalability: Suitable for Smart Cities Mission and hospitality clusters.

3 Smart Traffic & Transport Management

Solution: Intelligent traffic management system (ITMS) leveraging AI for real-time analytics, violation detection, and fleet monitoring.

Components:

- CCTV AI analytics for red-light jumping, wrong-side driving.
- Mobile apps for crowd-sourced alerts.
- GPS and sensor integration for public fleets.

Case Study: Seoul's ITS program improved traffic flow by 20% and emergency response times by 15%.

Benefits: Lower congestion, enhanced commuter safety.

4 Digital Underground & Urban Infrastructure Mapping

Innovation: Digital twins for both above-ground and sub-surface assets.

Technologies Used:

- UAV-based 3D scanning.
- Ground-penetrating radar (GPR).
- DGPS and BIM for integrated dashboards.

International Model: Singapore's OneMap and virtual underground grid reduced utility conflicts by 50%.

Relevance: High for Indian cities facing frequent utility disruptions.

5 Smart Hoarding & Sky Sign Management

Challenge: Illegal hoardings and unregulated signage leading to visual clutter and lost municipal revenue.

Solution: GIS-linked hoarding database, marketer portal, and real-time compliance checks using AI and IoT.

Technological Tools:

- Real-time monitoring sensors.
- Automated permit management.

Outcome: Revenue increase of 3-5x in pilot zones.

Comparable Case: NYC's automated billboard regulation system.

6 Smart Maritime & Port Logistics (Digital Twin + AI)

Overview: Deployment of digital twin technologies in port ecosystems to manage ship movements, logistics, and infrastructure health.

Components:

- LIDAR and GNSS for ship tracking.
- AI-based scheduling for berth allocation.
- Drones and SCADA for real-time monitoring.

International Example: Port of Qingdao, China implemented digital twins and cut turnaround time by 25%.

Benefit: Boosts port throughput and reduces demurrage costs.

References

1. *Smart Cities Mission India*
2. *Singapore Urban Redevelopment Authority*
3. *Seoul ITS and Waste Management Programs*
4. *Port of Qingdao – Digital Twin Deployment (2021)*
5. *RBI Report on Municipal Finance (2022)*

COE PARTNERS

EDGE COMPUTE

1. DRONE	
IdeaForge	One of India's leading drone manufacturers, known for its indigenous UAVs used in defense, surveillance, and industrial applications.
Garuda Aerospace	Specializes in agricultural drones, industrial inspection drones, and delivery drones.
Asteria Aerospace	A Tata Group backed company focused on security and surveillance drones.
Aarav Unmanned Systems	Offers enterprise grade drones for mapping, agriculture, and industrial applications.
Paras Defence & Space Technologies	Engages in the development of defense grade drones and UAV technologies.
Zen Technologies	Develops military drones and UAV simulators.
Hindustan Aeronautics Limited (HAL)	Manufactures drones for defense and reconnaissance purposes.
Bharat Electronics Limited (BEL)	A government owned company producing UAVs for military applications.
Tata Advanced Systems	Works on indigenous UAV technology for defense and commercial applications.
Dronitech	Focuses on AI powered drones for industrial automation and inspections.

1. DGPS	
Leica	Positional Accuracy
CHC	Navigation and Tracking
SOKKIA	Field Devices with Accurate Measurements
Geomax	Field Survey Instruments
Trimble	Field Survey, Navigation and Tracking Devices

FRONTIER TECHNOLOGY

1. Artificial Intelligence (AI)	
Anthropic Ai	A General AI (AGI) which makes AI assistants and is dedicated to building reliable, understandable and manuverable general AI For instance, one of Anthropic's papers explored how to train a general language assistant to be helpful to users, without providing harmful advice or exhibiting bad behaviors — something certain AI systems have been accustomed to do at times.
Open AI	An AGI company Although AGI does not technically exist yet, OpenAI is one of the few companies to come close with the invention of GPT-4, a large language model, which uses deep learning to produce human-like text and understand images.
Google Deep mind	Google DeepMind is perhaps best known for developing the Gemini AI models and the MuZero AI-based computer program.
Darktrace	Darktrace's self-learning AI helps protect companies' data and infrastructures from cyber threats by detecting them in real time. The platform works by analyzing network data and creating probability-based calculations, detecting deviations from typical behavior to identify threats. When Dartrace detects suspicious activity, it can put a stop to it before it causes any damage. Several major companies across the financial, healthcare, media and education sectors have relied on Darktrace for protection.
Evolv Technology	Evolv Technology's weapons detection scanner is designed to keep public venues safe. The portable system is able to screen hundreds of people an hour, allowing them to walk straight through at a normal pace, without stopping or having to remove anything from their pockets. Each machine is equipped with artificial intelligence and advanced computer vision, which is capable of detecting a wide range of metallic and non-metallic weapons. All the

FRONTIER TECHNOLOGY

1. Artificial Intelligence (AI)	
	data collected from a network of sensors is processed on one software platform that is "constantly learning" according to the company, meaning it can adapt and become more intelligent as new threats are discovered.
Hyperscience	Powered by machine learning, Hyperscience automates office work. Essentially, its AI-base software extracts information from documents, turning human-readable content into machine-readable data so any given task, from data entry to client onboarding, can be done autonomously, without the need for human intervention.
Graphcore	Graphcore has created a completely new processor — an intelligence processing unit, or IPU, which the company says will be an important part of the next step in AI's evolution. The IPU is built in such a way that it speeds up AI computing, allowing software architects working in machine learning to undertake all kinds of projects without having to worry about the associated compute power and bandwidth.
MindBridge	MindBridge's AI platform analyzes and detects errors in financial data, determines levels of risks for transactions and produces detailed risk assessments for financial institutions. While this may sound simple enough, its risk analytics technologies are in fact making big leaps toward the ultimate realization of AGI.
One Concern	One Concern was created to help communities prepare for, respond to and recover from natural disasters, providing decision-makers with the data and analysis they need to make more informed decisions. The company has essentially combined AI, machine learning and human-centered hazard science to create a digital twin of the physical world, which reveals potential risks posed to our built and natural environments by extreme weather and climate change, whether that be to specific structures or external networks communities depend on to function.

FRONTIER TECHNOLOGY

2. IOT	
Johnson Controls	Johnson Controls works to make buildings smarter. The company's systems and digital solutions include HVAC controls featuring sensors that optimize performance and electronic access control for automated security to manage employee and visitor building entry.
Spectrum	The company delivers mobile, internet, phone and TV services. However, organizations can request more secure connections through fiber technology for Ethernet access and other added perks.
Memfault	Memfault operates a cloud-based platform that monitors and remotely de-bugs connected IoT smart devices. It can keep track of metrics like battery health, memory usage and connectivity,, flag devices that haven't checked and assess the overall health of a fleet of devices.
75F	75F develops and manufactures IoT-based automation for building systems like HVAC and lighting that increase energy efficiency, reduce costs and increase comfort. It bring together hardware and software to control and optimize environmental factors like light, heat and air conditioning.
Superperdestrian	Superpedestrian uses design, robotics and mobile technology to develop human-powered mobility for cities. Its scooters are equipped with Vehicle Intelligence that conducts health checks in between rides, detects and corrects unsafe riding and alerts the company to parking issues.
Samsara	Samsara's sensor data solutions aim to enhance operational safety and efficiency for an array of industries. The company's connected sensors allow businesses to more easily manage, track and monitor operations within vehicles and fleets.

FRONTIER TECHNOLOGY

2. IOT	
GE Digital	GE Digital serves several industries, including aviation, utilities, life sciences and manufacturing. Among the company's products and services is the Predix industrial IoT platform with functions that support the workflows of multiple GE Digital applications.
Cisco	Cisco offers a suite of IoT products and solutions, including industrial sensors and connectivity management and automation.
Verizon	Verizon IoT keep track of vehicles, machines and kiosks to automate retail experiences and intelligent lighting for remote operations that make street lighting more energy and cost efficient.
ARM	Arm simplifies IoT connectivity for businesses from automotive and retail to logistics and smart buildings. The company says approximately 70 percent of the Arm-based chips shipped by its partners each year are meant for IoT and embedded markets.

3. Blockchain	
DHL	International logistics company. Besides aiding stakeholders and consumers to track medical products.
Accenture	Irish Technological company which focuses on technology and have collaborated with DHL for blockchain transactions.
Coinswitch	India's largest crypto platform, CoinSwitch is evolving into a wealth-tech destination. The company is on a mission to Make Money Equal for All, democratizing investing with a simple and safe platform built for India.

FRONTIER TECHNOLOGY

3. Blockchain	
Xillentech	They are a dynamic team committed to leveraging cutting-edge technologies to drive meaningful change in society. With a focus on sustainability and innovation, we are dedicated to crafting solutions that make a lasting impact on the world.

4. Wearable Technology	
SenseGiz Technologies	SenseGiz makes Enterprise IoT products for sensor based Condition Monitoring, Predictive Maintenance, Perimeter Security and real time asset/people tracking applications using a combination of proprietary mesh connected hardware, cloud, analytics and apps. SenseGiz has 3 patents granted in the US and in India.
Nexstem	create Brain-Computer Interface (BCI) solutions that help people interact with technology using their brain signals.

LEGACY SOFTWARES

1. Geographic Information System	
Gesix Solutions Private Limited	Provides GIS software and solutions for mapping and analytics.
ESRI India Technologies Private Limited	The official distributor of Esri's ArcGIS software in India.
Spatialmate Consultancy Pvt Ltd	Specializes in GIS software, remote sensing, and data analytics.
Hexamap Solutions Private Ltd	Offers GIS consulting, mapping, and software development.
ML InfoMap	Focuses on GIS based mapping solutions for urban planning and environmental monitoring.
GeoCentroid Pvt. Ltd.	Develops geospatial technology and location based services.
Spageo Tech	Provides GIS and geospatial solutions for government and private industries.
GeoIQ.io	Works on AI powered geospatial data analytics.

2. SCADA (Supervisory Control and Data Acquisition) system manufacturers	
Stretto Automation Pvt Ltd	Specializes in industrial automation and SCADA solutions
Scan Electronic Systems	Develops SCADA and process control systems for various industries
TSA Process Equipments Pvt Ltd	Provides SCADA solutions for process industries
Techport Solutions Pvt Ltd	Offers SCADAbased industrial control and monitoring systems
Omax Control Systems	Focuses on SCADA, PLC, and industrial automation technologies
Shrutek Automation Systems	Develops SCADAbased remote monitoring and control solutions
RR Techno Solutions	Engages in SCADAbased automation and industrial process control
Sanika Industries	Provides SCADA software and hardware solutions for industrial applications

LEGACY SOFTWARES

3. BIM (Building Information Modeling)	
Gensler	The BIM and IoT models are considered as a digital twin to the actual project to be analyzed and visualized by its asset data.
Perkinswills	A well-known global architectural firm, Perkins + Will is a leading BIM implementations along with VR (Virtual Reality) in the projects, so advanced that the firm has been looking into even more advanced
Zaha Hadid Architects	Zaha Hadid Architects has utilized cutting-edge technology to design through implementation of BIM
Skanska	Skanska is leading contractors and construction company and it has achieved Level 2 BIM verification from BSI for the 2016 BIM Level 2 mandate.

4. 3-D Digital Twin	
General Electric (GE)	GE Vernova provides a lineup of digital twins and monitors thousands of assets across the globe and alert teams of maintenance needs. It can conduct simulations to help companies improve grid performance.
Cisco	Cisco delivers a digital twin service through its cloud platform known as Digital Twin Explorer. Customers can map out an entire network to oversee various devices and analyze connections between specific devices
PTC	PTC's cloud platform with digital twin capabilities, can use to generate visualizations, assess systems and run simulations in real time.
Ansys	Ansys uses simulation programs to create predictive models for industries such as aerospace, automotive, defense, energy and healthcare. It creates digital twins of Physical assets like satellite systems, medical devices and semiconductors.

LEGACY SOFTWARES

4. 3-D Digital Twin	
Rockwell Automation	Rockwell Automation specializes in digital twins for manufacturing. The technology can enhance productivity and safety by allowing prototypes to be designed and tested in the digital realm to train in a low-stakes virtual environment before deploying their skills in the real world.
Bentley Systems	Bentley Systems digital twin integrates engineering, geospatial and operational data into a single view.

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